Appendix II: Estimating Process

1 Importance of Quality Cost Estimates

The reliability of project cost estimates at every stage in the project development process is necessary for responsible fiscal management. Unreliable cost estimates result in severe problems in DOTD's programming and budgeting, local and regional planning, and leads to staffing and budgeting decisions that hinder the effective use of limited resources.

1.1 Goal and Objective

DOTD's goal is to avoid project cost overruns. One objective is to identify "unforeseen items of work" before the project concept, scope, and budget have been determined; thus minimizing the differences between preliminary project planning cost estimates and final project design cost estimates. Identifying costly "unforeseen items of work" after the project has been programmed may stop or delay a project.

The term "project cost estimate," as used during the project development process, includes all capital outlay costs, including right of way, structures, utility, and landscaping. Project cost estimates should never be artificially reduced to stay within the funding limits, nor should they be reduced to provide the appearance that more projects can be funded. Likewise, project cost estimates should not be artificially raised beyond the contingency percentages provided for in this appendix unless adequately justified.

2 Consistent and Comprehensive Methodology

It is acknowledged that cost estimating is not an exact science. However, DOTD must strive for reliable project cost estimates, so that projects can be delivered "within budget." To this end, it is required that project cost estimates be prepared using a consistent and comprehensive methodology. Even with a consistent and comprehensive methodology, careful attention is needed to ensure a quality cost estimate. The cost estimator needs to research, compare and, above all, use their professional judgment to prepare a quality cost estimate.

2.1 Identify Contract Items of Work

The identification of available funding allows the project to transition from the environmental and planning phase to the design phase. At this time, all of the significant project features should be known and many contract items of work can be identified. In addition, the items of work

identified and estimated during the project planning phase should now be better defined as design work progresses.

2.2 Staying Current

Cost estimates, in a sense, are never completed. If allowed to remain static for extended periods of time, they will become outdated and unreliable. This may be for a number of reasons both project related as well as non project related. Examples of non-project related factors may be market trends and labor cost, availability of materials and contractors, or changes to specifications, both design or construction.

2.3 Contingencies Versus Confidence Factor

Contingency factors for project planning cost estimates vary depending on what stage the project is in, the type of project, and the confidence of the estimator. Contingencies are intended to compensate for the use of limited information. The percentage should go down as the project becomes more defined and thus less unknown. Contingencies are not intended to take the place of incomplete design work. Project alternatives and their associated cost estimates must be thoroughly compiled by diligently using all the available data, modifying that data with good judgment and using past cost estimating experience and appropriate contingency factors so that the cost estimates can be used with confidence.

2.4 Documentation

Typically, the planning and development process for a project occurs over a period of several years and many decisions and agreements are made. All too frequently during this time, project personnel, project site conditions, or philosophical position changes occur that can affect the continuity and accuracy of earlier project decisions. To help alleviate this situation, all project decisions, agreements, design criteria, and constraints should be thoroughly documented and retained in the project files. This philosophy also applies to notes, decision, photos, and mapping used during field reviews of the project site.

3 Prepare Reasonable Cost Estimates

Estimators are expected to prepare reasonable project cost estimates that represent the total cost to complete the project. Experience has shown that project cost estimators should consider the following factors that can affect the cost of projects.

3.1 Traffic Conditions

Traffic conditions have a significant affect on costs. Estimated prices should be adjusted to reflect difficulties, dangers, and risk due to exposures caused by traffic conditions. Considerable deliberation should take place to balance decisions affecting costs and traffic handling and safety.

3.2 Restrictive Work Hours or Method of Work

Restricting the contractors working hours or the method of work on a project will usually have major affects on costs. The cost for work that is limited to short shifts, or required to be completed in long shifts, or limited to nighttime operations should be increased to reflect the cost of premium wages required for such work and for the general inefficiencies and decreased productivity that may result.

3.3 Quantities of Work

Small quantities of work typically have higher unit cost than identical work in larger quantities. This is due to mobilization as well as overhead and other such costs that must be distributed over a smaller base. Production rates are also less efficient and are usually lower for small quantities, which tend to increase unit costs.

3.4 Geographic Location/Site Conditions

Geographically remote locations usually result in higher costs. Consideration should be given to availability of skilled labor, suppliers, and materials. Environmental conditions and site specific accessibility factors may also contribute to higher unit cost. Urbanized areas with limited right-of-way can also result in higher costs.

4 Monitoring and Updating Cost Estimates

All project cost estimates are to be monitored and maintained current in LETS and PPMS. Following the initial estimate, the timing of the updates is guided by the following factors:

4.1 Annual update

All cost estimates must be kept current by updating at least once a year. This annual update is only necessary if the estimate is not updated for any of the reasons listed below. If no new project information has come about and no changes in scope have occurred, this update would focus on unit price changes as a result of inflation or other market conditions.

4.2 Project Stage Cost Estimate

A current cost estimate is needed at the end of each project stage. This value is used during the course of the subsequent stage for up to one year or until something changes or more accurate project detail is known.

4.3 Significant Changes in Identified Project Costs

Other appropriate times to update the project cost estimate is when a project development workflow task supports the preparation of a more detailed cost estimate (i.e., when a task involves an activity to review the project and create a cost estimate). Examples of this include when a preliminary site investigation more clearly identifies a hazardous waste problem, or when a materials report clarifies the foundation conditions.

5 Stage 0 Cost Estimate

5.1 Initial Cost Estimate

For most projects, a feasibility cost estimate is required to determine financial feasibility and whether or not to proceed with development of a project initiation document. It is prepared prior to the project initiation process and prior to initiation of project, environmental and planning studies.

5.2 Methodology

It is understood that for project cost estimates developed at the time of project initiation, sufficient data may not be available to prepare a detailed estimate. However, the need for project cost information at very early stages is necessary for "go/no-go" decisions. Although this information is not used for programming the project, it is vital that it be comprehensive, realistic, and consistent with known information.

In years past, when the majority of state highway projects were new roadways on new alignment with a very well defined scope, project feasibility cost estimates were prepared using a variety of methods. The most common method was a cost per mile basis for a particular type of facility. Today, the majority of projects either maintain or improve the operation of the existing system. Cost estimates for these projects are more difficult to scope and cannot, and should not, be determined by a "windshield survey."

5.3 Scoping for Project Feasibility Estimates

The project feasibility cost estimate is intended to determine an order of magnitude for the project. It is essential, therefore, that the project be adequately scoped with a clear understanding of the purpose and description of the proposed action. The "worse probable case" scenario

should always be assumed, particularly on reconstruction projects. Existing facilities thought to be adequate may become inadequate because of changes to standards, new data, further deterioration prior to construction, etc.

5.4 High Cost Items

A thorough understanding of the proposed action or project combined with "hands on" site reconnaissance surveys, with input from local district personnel and others, is necessary for most significant projects. This will assist estimators' awareness of high cost items that must be quantified such as: costs of mitigating hazardous waste and other environmental impacts, major utility relocation, noise barriers, retaining walls, major storm drains, transportation management plan, traffic handling, etc.

5.5 Real Estate

This policy is designed to increase the reliability of Real Estate relating to proposed projects at various stages in project development.

The Real Estate section will develop a database of unit values for various types of projects. A cost-per-mile schedule will be developed that can be correlated to most all proposed projects in a given area of the state. The database will be developed for each of the following: rural widening, rural four lanes, urban five lanes, urban widening, rural to urban widening, rural to urban four-laning, bridges. The Design section will assist Real Estate in identifying the various types of projects that have already gone to letting so that historical data can be used to develop the schedule. The cost-per-mile approach will work in areas where property values are stable; however, in progressive commercial urban areas where property values are increasing at a high rate, a more detailed approach must be used. The estimator should consider using recent similar comparable sales and assess the full extent of the owner's loss impacts on owner-occupied business and residences, since this is one of the considerations that can significantly drive up acquisition costs. This more intensive analysis can be performed at any stage of the projects, but the accuracy of the estimate is dependant on Design providing sufficient project taking data and other design features.

When the estimate is requested, the type of project should be provided along with the total width and length of the project as well as a map showing the location of the project. The project should be described in a manner so that the appraiser/estimator can clearly understand the amount of additional right-of-way that will require a cost estimate. The proposed length of the project should be easy to identify.

Upon receiving the request for a Stage 0 estimate, the Real Estate Chief Appraiser will assign a staff appraiser to prepare the estimate. The estimator will evaluate the database and choose the most recent comparable project to apply the unit cost per mile and apply a 20% contingency to the estimate to compensate for appreciation in property value. If the project is in a high commercial urban area where property values have been appreciating at a high rate, the estimator should apply recent comparable sales and make an onsite inspection or increase the contingency rate accordingly.

5.6 Utilities

The Utility unit will furnish the Real Estate section the total cost that has been set up for utility relocation at the completion of the project along with the total number of utilities. This total cost for utilities is the sum of the total agreements amount plus the total URAF agreements for each project. To start this process the Utility Unit will analyze all the projects that were let over the last calendar year. Then they will input new data as soon as the projects go to letting that involve utilities and right-of-way. This cost information will be matched with the Real Estate database for cost estimates for both Real Estate and Utilities. A cost per mile will be established for completed projects and unit costs will be available in each geographical area of the state for various types of reports.

When the Utility Estimates are requested, the Headquarters' Utility Relocation Specialist will utilize the most comparable projects in the Cost Estimate data base to establish a cost estimate for utilities on this project. The Design Utility Specialist will need to provide the estimated amount of the high cost utility items and provide a list of the names of the utility companies that are affected. This collaboration between the Headquarters and District Utility Specialist will provide the most reliable utilities relocation estimate.

A clear understanding of the length of the project and the type of project that requires an estimate must be made available to the Headquarters' Utility Relocation Specialist. A 20% contingency must be applied to the estimate arrived from the data base to compensate appreciation in utility cost to account for inflation, etc.

5.7 Bridge Design

These initial project estimates are usually developed based on historical data. Previously constructed projects with similar characteristics are used to generate the base unit cost of the major items contained in the project. The existing bridge structures are reviewed and a projection is made of the type, size, and location of the new structure along with any major construction-related items such as maintenance of traffic, site characteristics, contractibility issues that may impact the cost estimate.

A preliminary analysis is performed by the Bridge Representative to establish the feasibility of the proposed project. The development of the estimate is based on the estimated bridge improvement and historical bridge cost data.

Major structures require an in-depth review to determine the requirements for navigation, navigational clearances, alignments studies, and traffic studies to determine bridge typical sections and maintenance of traffic needs. A site visit with knowledgeable local persons is necessary for most projects.

The development of the preliminary estimate is based on historical cost of similar projects equated to the square footage of deck area for proposed bridge structure. A contingency factor of 25% of the bridge-related cost will typically be applied at this stage to account for unforeseen items.

Items that may be considered at this stage in the cost estimate are as follows:

Types of Structures

1. Slab Spans
2. Concrete girder spans on pile bents
3. Concrete girder spans on column bents
4. Steel girder spans on pile bents
5. Steel girder spans on column bents
6. Interchange with complex geometry
7. Moderate river steel spans with/without vessel impact
8. Major river steel spans with/without vessel impact
9. Railroad overpasses fill/cut section
10. Low/Mid/High level movable

Other Considerations

1. Type of construction i.e., end-on, split slab
2. Detour structure or scheme
3. Hydraulic issues (site specific)
4. Geotechnical issues (regional specific)
5. Preliminary design criteria

5.8 Road Design

Initial project estimates are based on the available information furnished including the projected limits, proposed typical section, existing roadway configuration and other historical data concerning the route. The estimator needs to have an understanding of the proposed scope and purpose of the project. Road Design will establish a cost for the different types of improvement that are generally planned. This information will be housed in the Road Design section and will be updated on yearly basis using bid prices for similar type projects let to contract during the last year and over a three year period to develop trends in construction cost. This information will be based on a per mile basis and general interchange configurations.

Items that need to be considered are:

1. Number of proposed lanes
2. Existing roadway type and condition
3. Rural vs. urban design
4. Project traffic volumes
5. Anticipated construction restraints
6. Handling of traffic during construction
7. Required drainage improvements
8. Lighting/signalization

6 Stage 1 Cost Estimate

Cost estimates are prepared continuously throughout the development of alternatives in the environmental process. Since the project cost estimate is prepared as part of the project approval process, it should be made after completion of the public hearing process, selection of the preferred alternative, and completion of the environmental document.

The project cost estimate is prepared using the same format as used for the other project planning cost estimates. However, since the preferred alternative has been selected, the project cost estimate can now be more definitive. It is now tied directly to a specifically defined project scope and description and becomes part of the project scope and budget report.

6.1 Real Estate

The estimator will use the same database as described above and apply the more recent data from similar projects. In progressive urban areas the estimator should perform a detailed estimate using recent comparable sales for land values, including improvement values, damages,

relocation cost, added percentage for administrative settlements and expropriation cost applied to the total estimate. The Real Estate estimates in Stage 1 should also be updated at a 10% yearly rate except for the progressive urban areas of high density commercial properties where a 15% to 20% per year increase should be applied.

6.2 Utility

The estimator will use the same database as described above and apply more recent data from similar projects. The Headquarters' Utility Specialist will request the District Utility Specialist to make an onsite inspection to determine if there are any abnormal cost items for utility relocation and provide the estimated cost of these items. The District Utility Specialist will also be asked to estimate the number of utility companies on the proposed project. A 20% contingency will be added to compensate for inflation and to complete the estimate. For the updated estimate, the most recent database plus 20% contingencies would be used. This estimate will include the correlated cost by the use of the database, plus the cost of abnormal items provided by the district and the 20% contingency rate.

6.3 Bridge Design

A preliminary evaluation is performed by the Bridge Representative for the proposed bridge improvement. The estimate is updated based on the historical bridge cost data applied to the proposed improvement accounting for any additional information gained since Stage 0.

During this stage additional information is gathered by the bridge representative and a further definition of the bridge improvement is made. The information available during this stage usually consists of the following:

1. Site visit
2. Proposed Design Criteria
3. Long range plan for the route
4. District questionnaire
5. Additional aerial photography if required
6. Proposed maintenance of traffic scheme
7. Master structure files NBI data and existing bridge configuration
8. Navigational vessel data
9. Preliminary geotechnical data
10. Traffic study
11. Environmental documentation and finding
12. Identification of selected alternate

During this stage of the project, traffic data is gathered, a navigational clearance is identified, the alignment is studied, and the bridge structure type is refined. Consideration is given to match the construction technique to the maintenance of traffic and environmental conditions.

The estimate prepared in Stage 0 is revisited and adjusted to incorporate new information gained during Stage 1. The estimate is based on historical cost of similar projects equated to sq. ft. to deck area for proposed bridge structure. A contingency factor of 20% of the bridge-related cost typically will be applied at this stage to account for unforeseen items. Estimate magnifiers should be applied to the estimate to account for cost increases due to known constraints or conditions.

6.4 Road Design

Prepare a cost estimate during this stage based on major items such as average fill and/or cut, area of clearing and grubbing, mobilization, signs and barricades, base course items, pavement items, major cross drains, average size for subsurface drainage including catch basins based on a closer defined length of project, updated unit prices, and other information concerning detours and sequencing of construction phases if known. Multiply cost of major items by 1.4 to cover the cost of other items such as removals, stripping, construction layout, fencing, and other minor items. Compare this estimate to the estimate prepared in Stage 0, retaining the highest.

Available information

1. Defined limits of project
2. Aerial photography
3. Parish maps and/or city maps
4. Proposed typical section type, (overlay, replacement, widening)

Needed information

1. Proposed scope (intersection improvement, adding two lanes to existing two lane, widening from two lane to three or five lane urban, complete new construction of two lanes or multi lane, or building an interchange)
2. Existing and project traffic volumes
3. Preliminary typical section design
4. Proposed vertical and horizontal grade
5. Geometric layout of intersections and interchanges

7 Stage 2 Cost Estimate

The process for developing a Stage 2 estimate is only applicable for projects that remain in this stage more than one year. If this is the case, the estimate should be reviewed to determine if any new pertinent information has come about, if any department policies or design specifications or criteria have changed that would impact the values and assumptions previously made in the estimate documentation. Inflation or increased in base line unit costs for other reasons may necessitate investigation and updating.

8 Stage 3 Cost Estimate

For most projects the minimum level of project development that is necessary to accurately identify the costs and delivery schedule of a project occurs at the preliminary plans stage. A preliminary plan is required for every project. The plan is developed to show preliminary geometric details, and includes final design criteria, proposed line and grade, tentative right of way, preliminary intersection or interchange layouts, bypasses, and pertinent topographic features.

As with Stage 2 estimates, reviews/updates are required one year from the date of the last estimate or at completion of final preliminary plans, whichever comes first. At the final preliminary stage, most controlling project information should be finalized, including limits of construction and required right of way, traffic control plan, plan quantities for all major items, construction time, sequence of construction and limitations, environmental and hazardous waste mitigation, and utility relocation plans.

At this level of project development, preliminary plan quantities will be used together with historic cost data to produce the estimate of construction cost. A description of how the historic cost data is collected is described in the following sections. Right of way estimates will be based on the tentative right of way lines identified in the preliminary plans. Also at this point in the project development process, any unusual conditions or costly items, such as major utility adjustments, should be identified.

When final construction plans reach the 95% (ACP) stage, all construction bid pay items have been identified and an ACP cost estimate is prepared. The major pay items utilized in final preliminary plans are now final and the percentage values used for the remaining items are now replaced with the actual pay quantities items. No contingency factor is used and magnification

(plus or minus) is incorporated into individual historic pay items to account for size of quantity, site accessibility, availability of materials, etc.

Upon completion of the project final design plans, the Engineer of Record prepares the final cost estimate for the project prior to submittal of the plans, specification and estimate (PS & E) to Project Control for advertisement, letting, and award of a construction contract. This estimate is prepared using the bid items and plan quantities derived from the completed final plans and applying the applicable historical unit cost data to bids.

This estimate becomes the basis for the engineer's estimate that is prepared by the project manager. The engineer's estimate is a tool that will be used to analyze the bids received on the project. The engineer's estimate is completed immediately before receiving bids on the project and therefore considers the most current price data.

8.1 Real Estate

The estimate should be updated at 60% right-of-way maps corresponding to the joint plan review. The chief appraiser shall assign a review appraiser and a staff appraiser or consultant to perform a detailed cost estimate utilizing recent comparable sales to develop the land value. The estimate shall also contain the estimated damages including full extent of owners' loss. The chief appraiser will utilize the estimate developed by the staff appraiser and review appraiser and make necessary adjustments for administrative settlements, legal settlements, court awards, real estate/legal consultant fees, expropriation costs, etc. Relocation assistance estimate costs will then be included to determine the final estimated real estate cost estimate. Real Estate should correlate the detailed estimate to the real estate cost developed from the database. If the correlation is close in the future, real estate might be able to have funds set up on a majority of the projects from the unit cost developed from the database from old projects.

8.2 Utility

At 60% right-of-way maps, Stage 1 processes are used. However, utilizing the most recent data base, plus the district utility specialist, will provide a better estimate on the number of utilities and the abnormalities that drive the utility relocation costs. The abnormalities are pipeline crossings, electric transformer units or any structure that the cost would be 100% state/federal funded. The headquarters' utility relocation specialist would add the additional costs from the district to the correlated costs from the most recent data base to arrive at the estimated costs for utilities. A 20% contingency should be added to complete this estimate. The total cost of utilities will be transmitted to the Real Estate Chief of Acquisition who will combine this estimate with the Real Estate estimate and request Project Control to set up the funding.

8.3 Bridge Design

Cost estimates for the bridge plan portion of projects and related structures are developed based on final preliminary plans that will include quantities for all major items. At this time, the final design criteria establishes the bridge typical section, bridge length, and type as well as the construction sequence and technique. Hydraulic information including predicted scour and back water has been incorporated and the geotechnical data has been received. A foundation plan has also been developed. The need for a pier protection system and maintenance of marine traffic has been considered. Magnifiers will be used to compensate for various conditions of the project such as project size and complexity. At this point a contingency factor of between 10% and 15% is recommended.

8.4 Road Design

At 95% preliminary (pre plan-in-hand), a new estimate should be prepared based on major items that will be included in plans such as earthwork, paving, drainage items, permanent signing, lighting signals, mobilization, temporary signing, and any special sequencing and items for handling of traffic. This estimate should be based on the latest available unit prices. Multiply cost of major items by 1.25 to cover cost of all other unknown items. Compare this estimate to the previous estimates to make sure that all items are covered.

At ACP stage, another cost estimate should be prepared based on all items using the latest unit prices. A revised estimate should be prepared after all ACP comments have been addressed. A contingency of 10% is recommended.